

Evolving Maturation of the Series-Bosch System

Human exploration missions to Mars and other destinations beyond low Earth orbit require highly robust, reliable, and maintainable life support systems that maximize recycling of water and oxygen. In order to meet this requirement, NASA has continued the development of a Series-Bosch System, a two stage reactor process that reduces carbon dioxide (CO_2) with hydrogen (H_2) to produce water and solid carbon. Theoretically, the Bosch process can recover 100% of the oxygen (O_2) from CO_2 in the form of water, making it an attractive option for long duration missions. The Series Bosch system includes a reverse water gas shift (RWGS) reactor, a carbon formation reactor (CFR), an H_2 extraction membrane, and a CO_2 extraction membrane. In 2016, the results of integrated testing of the Series Bosch system showed great promise and resulted in design modifications to the CFR to further improve performance. This year, integrated testing was conducted with the modified reactor to evaluate its performance and compare it with the performance of the previous configuration. Additionally, a CFR with the capability to load new catalyst and remove spent catalyst in-situ was built. Flow demonstrations were performed to evaluate both the catalyst loading and removal process and the hardware performance. The results of the integrated testing with the modified CFR as well as the flow demonstrations are discussed in this paper.